

## Operating Room Design: “The Devil is in the Details”

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No perfect operating room (OR) exists and many, if not most, surgeons have complained about their workplace at one time or another. But just imagine if you had complete control over the design of your operating room and could fashion it as you pleased. What would you change? Where would you begin? Certainly, many surgical salespersons would like to sell their product, but would that product be right for the patient, right for you the surgeon, right for the nurses, right for administration, and right for the payers who ultimately fund hospital activities? Importantly, does the OR design change represent your needs, or, in fact, does that change represent your wants?

Philosophizing about what represents an optimal operating room turns out to be easier than actually designing one. In reality, it is not just the surgeon who is concerned with an operating room. Many constituents are intensely interested in the OR, and these constituents frequently have different agendas. With modern, complex operating rooms, great attention must be paid to the “details.” A huge problem can lurk in just neglecting one small detail, and with operating room design “the devil is in the details.”<sup>1</sup>

Technology has driven operating room design since the earliest times. That technology may have been “low tech,” such as access to prevailing light or proximity to patient floors. Or it may have been “high tech,” such as machines that sterilize instruments or devices that administer anesthesia. In either case, technology was utilized to benefit patient care and empower the surgeon to perform interventions not possible in any other setting.

In today’s age, technology has continued to determine operating room design. Voice activated controls, robotic devices, and incorporation of the developing science of ergonomics has changed how we think about operating rooms. Operating rooms constructed in the 20th century

are different from those designed at the end of the 19th. And those of the 21st century promise to be very different from those of the preceding century.

For instance, “low tech” areas, such as the physical plant and basic surgical instruments, have garnered intense study. It is recognized that patient flow through a system is important and that the integration of patient flow with the processes of preoperative care, operating room transfer, and postoperative recovery is important for the expeditious, cost-efficient management of a surgical case.

Instrument design has been studied to increase durability of the instrument and ease of cleaning. Attention is also being directed to the ergonomics of instrument design. Changes have been made in standard instrumentation that relieve surgeon fatigue and improve ease of handling. The ability to render patient care has improved.

“High tech” areas have not been neglected. Surgeons have almost instantaneous computerized access to medical databases for reference to records and the latest information on disease management. Technologies (ultrasound and fluoroscopy) now exist that enable a surgeon “to see” disease better than ever before. Robots are available to maneuver laparoscopes and surgical instruments. Manipulator systems can change the ratio between the input and output movement of a surgical instrument. Movement and force of the instrument thus can be scaled upward or downward providing the physician with unparalleled control of that instrument and the operative procedure.

All of the above represent a potential for significant improvement in operating room design and point the way to the future. However, what a 21st century operating room will actually look like and what technologies will become dominant are unclear.

An incremental change toward the future, and possible today, is to adjust current technologies and the way they interact. Power cables from electronic devices, suction tubing, IV lines, and electrosurgical wires literally litter OR floors and often block access to the patient. Moreover, these “umbilical cords” of technology are a hazard to those moving about the operating room in the darkened environment of laparoscopic surgery or during

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fluoroscopic procedures. A simple "low tech" advance to eliminate the clutter would be to embed these lines into the floor or suspend them from the ceiling.

Another progressive, incremental change towards tomorrow's OR would be to install a system – perhaps modular – that gathers all of the commonly used medical devices into one, two, or three units. These units would be integrated with the hospital's communication system, information management, OR environmental controls, and robotic devices. Not only would all units be controlled from the circulating nurse's station apart from the operative field, but they would also have the capability of being controlled (with touch screen or voice activation) from within the operative field. The surgeon would have command of the OR environment (lights and temperature) and laparoscopic units, access to medical databases, and communication with medical records, pathology or the X-ray department. Importantly, this control would be instantly available to the surgeon and not subject to the attendance of a circulating nurse.

A system that integrates medical devices into a tower or suspends them from the ceiling would "clean up" the OR floors of cables, electrical wires, and suction tubing. Working space would be maximized and movement within the operating suite would be more efficient and safe. Integrative technology, which is available today, can be used to upgrade the majority of operating rooms in this country.

Other systems that improve a surgeon's operative capabilities (ie, robotic technologies and ultrasound technologies "to see" disease) are only slightly more distant in the future. And although use of visualization technologies is becoming more widespread, potentially contentious areas are associated with several of them. For example, credentialing for ultrasonography (who can use the devices, interpret the images, and be reimbursed) needs to be addressed and clarified. Issues that cross specialties should be discussed and a consensus reached locally at each institution.

Before the new operating room is constructed, "small" details, such as who will be responsible for planning the OR and implementing those plans, need to be finalized. Hospital administration needs to identify the major vendors as well as the groups of surgical specialists who will be using the new instruments and technologies. The institution's information systems must be integrated into the OR suites. These "details" will incur heavy penalties if not

set to rights beforehand. Additionally, the specialists responsible for interpreting data and images, and those who are permitted to bill for these services along with other niceties need to be reviewed in advance. In all these deliberations of how to utilize technology and design an OR, the patient's best interests must be balanced against cost and realizable goals.

Robotic devices are capable of decreasing operator fatigue and enhancing human performance. In addition, surgical workstations have the potential to improve visualization of the operative field, improve the ergonomics of surgical intervention, and, when indicated, isolate the operating team from contagious patients. However, whether these technologies are built into one room as a unit, or whether they are modular with the capability to "add-on" or change are decisions that need to be made before the operating room is constructed. Extensive discussion with all major departments associated with the operating room is essential to prevent any single detail from becoming a "devil of a problem."

Environmental services, the outpatient department, nursing service, anesthesia, risk management, finance, personnel, maintenance, and information management also have important interests in the operating room. Their voices must be heard. And just as "all politics are local," so should the planning and design of a hospital's OR be local.<sup>2</sup> An outside firm may provide information and support, but those who use or service the operating room must determine its needs.

It is almost impossible to visualize the 21st century operating room, but it is possible to outline trends. Certainly, the new ORs will not resemble today's OR. As one sage opined, "The future ain't what it used to be."<sup>3</sup> With planning and attention to detail, however, a solid foundation for the future OR can be laid and used to meet the unique needs of each individual institution.

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